Winter Crop Evaluation for Silage and Forage Quality in Korea

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Introduction

Winter crops of rye, barley, oats and Italian ryegrass are used alone or combined as silage crops or green forage in autumn and spring in Korea. The production and utilization of winter crops have been increasing since 2000, because of high yield and double cropping potential in the rice field after harvesting rice. An advantage of these winter crops is that they are produced in the cool season. However, a main problem in making silage with these winter crops is that they are sometimes poor in quality for various reasons.

Therefore we conducted a survey of farms and forage selling cooperatives, on forage and silage quality for the last five years.

Methods

We collected 475 silage samples from farms and forage cooperatives for evaluation of winter crop quality from 2008 to 2012. The experimental design was a completely randomized design with 4 winter crops. Samples of rye (Secale cereale), Italian ryegrass (Lolium hybridum), barley (Hordeum vulgare) and oats (Avena sativa) were dried in a forced air over at 65°C for 72h to determine dry matter. Representative samples of winter crop silage were analyzed for the moisture, pH, ash, crude protein (CP), neutral detergent fiber (NDF), acid detergent fiber (ADF), non-fiber carbohydrate (NFC), total digestible nutrients (TDN), relative forage quality (RFQ) and organic acid (lactic acid, acetic acid and butyric acid). Crude protein was determined by the Kjeldahl method (AOAC, 1990), NDF and ADF were measured by the method of Goering and Van Soest(1970). NFC, TDN and RFQ were calculated from the following equation (NRC, 2001; Moore and Undersander, 2002):

NFC=OM-NDF-CP-EE, TDN= (NFC×0.98) + CP×0.87) + (FA×0.97×2.25) + (NDFn×NDFDp/100) - 10, RFQ = DMI × TDN / 1.23. OM = organic matter (% of DM), EE = ether extract (% of DM), FA=fatty acids (% of DM) = ether extract (EE)-1, NDFn = nitrogen free NDF = NDF × 0.94, NDFDp = 22.7 + 0.664 × NDFD, NDFD = 48 - hour in vitro NDF digestibility (%NDF), DMI = dry matter intake.

Results and Discussion

The results were summarized in Table 1**.** The moisture, NDF, ADF, NFC, TDN, RFQ, lactic acid, and total organic acid have significant differences among winter crop silage (P<0.05). However, there were no significant differences in other chemical composition (CP, Ash, pH, acetic acid (ACE) and butyric acid (BUT)). The RFQ (relative feed quality) value of barley was higher than that of other crops because of high NFC and TDN contents, and lower NDF and ADF contents. Lactic acid and total organic acid of IRG were also higher than those of other winter crops. This experiment indicates that lactic acid of the silage was good indicator for evaluation of whole crop barley silage. Differences in forage quality were also observed among winter silage crops.

Conclusions

Differences in forage quality were observed among winter silage crops. Barley had the highest forage and silage quality among winter crops. This experiment indicates that lactic acid of silage was good indicator for evaluation of winter crop quality. Oats and Italian ryegrass were good for winter silage crop in term of TDN, CP, and lactic acid.

Table 1. Comparison of silage quality in winter crops (% of dry matter basis)

Winter crops	Moisture	NDF	ADF	NFC	TDN	RFQ	LAC	ORG
Rye	58.6 ab	62.6 ab	40.2 a	21.1 b	57.2 b	109 b	1.89 b	2.60 b
Italian ryegrass	55.5 c	60.6 b	38.6 a	23.3 b	57.5 b	108 b	2.71 ab	3.36 ab
Barley	64.3 a	53.5 c	34.3 b	29.7 a	61.5 a	130 a	3.30 a	4.43 a
Oats	58.8 ab	65.2 a	41.5 a	19.9 b	55.8 b	102 b	3.19 a	3.82 ab

NDF=neutral detergent fiber, ADF=acid detergent fiber, NFC=non-fiber carbohydrate, TDN=total digestible nutrients, RFQ=relative forage quality, LAC=lactic acid, ORG=total organic acid.

References

AOAC (1990) Official method of analysis. 15th ed. Washington, DC.

Kim Jong Duk, Chan Ho Kwon, Hyo Won Lee, Chang-Hyun Kim (2012) Organic forage production system for animal production in Korea. Proceeding of the 4th Japan-China-Korea Grassland Conference, pp.24-29.

McDonald P (1981) The biochemistry of silage. John Wiley and Sons Ltd. England.

Moore JE, Undersander DJ (2002) A proposal for replacing relative feed values with an alternative: Relative forage quality. pp. 171-175. In 'Proceedings of the American Gasslands and Forage Council, Georgetown, TX, 14-17 July 2002. (Ed. K Cassida)

National Research Council (2001) Nutrient requirements of dairy cattle, 7th rev. ed. National Research Council, National Academy Press, Washington, DC.

Seo S (2009) Development of new varieties and production of forages in Korea. *Journal of The Korean Society of Grassland and Forage Science* **29** (Suppl.), 1 - 10.